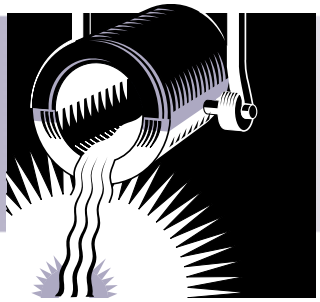
METAL CASTING

Project Fact Sheet



ADVANCED COATINGS FOR DIE CASTINGS

BENEFITS

- Improves the quality of die casting coatings and therefore die casting dies.
- Extends die life
- Improves cost competitiveness of die cast components.
- Reduces downtime in die casting operations.
- Expands the range of light weight die cast components which can be used in automotives thereby improving fuel economy. This could save an estimated 29 billion Btu in 2020.

APPLICATIONS

Improving the efficiency and process economics of die casting by using surface engineered die coatings will extend the range of die cast components that can be produced. This will increase opportunities for die cast components in motor vehicles and other applications.

SURFACE ENGINEERED COATING SYSTEM WILL EXTEND DIE LIFE AND IMPROVE COST COMPETITIVENESS OF DIE CAST COMPONENTS

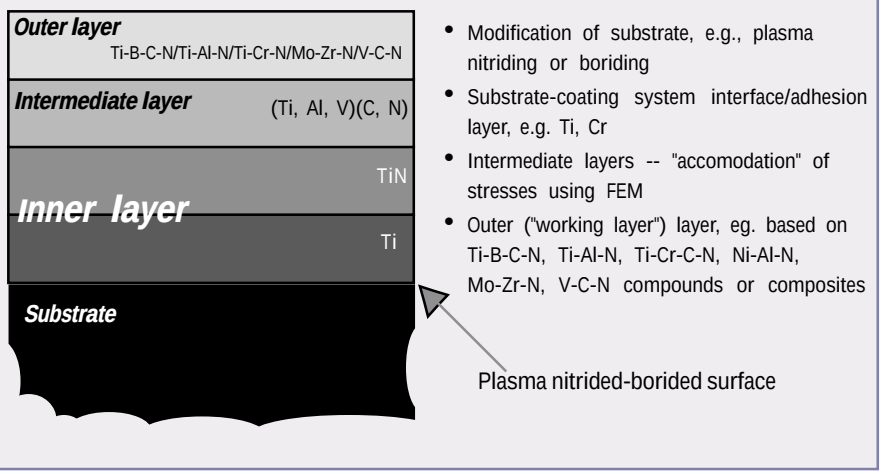
Die wear and failure are significant issues in die casting. Major causes of premature die failure include heat checking (thermal cracking), erosive wear, and corrosion. Therefore, three of the most important performance criteria for die coatings are wear resistance, non-sticking, and corrosion resistance. No single coating provides an optimum system. Optimum systems must be specially designed using multi-layer architecture. Each thin-film layer of the coating system has a specific purpose. The thin-film adjacent to the substrate must provide good adhesion; the outermost "working" layer must provide the required corrosion/oxidation and wear resistance and non-wettability, while the intermediate layers provide the required accommodation and minimization of thermal and residual stresses.

In this project, the most promising coating systems for die casting aluminum alloys are being designed and tested. These coating systems are intended to minimize premature die failure and extend die life. Appropriate architectures for each of these coating systems will be proposed for die casting dies.

Surface engineered die coatings can improve the cost competitiveness of die castings thus enabling a wider range of die cast components that can be used in automotive and other applications.

Research partners include the Colorado School of Mines, Ohio State University, and the North American Die Casting Association.

CONCEPTUAL DESIGN



Surface engineered coatings for die casting dies.

Project Description

Goal: The objective of this research is to develop a coating system that minimizes premature die failure and extends die life.

The initial research program will concentrate on developing a coating system for dies used in die casting aluminum alloys. The outcomes from this research program will quantify comparisons of the current aluminum die casting practice with the measured results using the newly developed coating systems. A comparison of cost and performance will also be determined for the new coasting systems using current cost data as the base line.

Progress and Milestones

This three-year project began in February 2000. Planned activities include:

- **Evaluate Outer Layer Coatings** - The mechanical, physical, and chemical properties of the most promising thin films will be evaluated and assessed in order to make a selection of the three or four films which are thought to provide the most potential for this application.

- **Optimize Coating Architecture** - Systematic finite element analysis will be conducted in order to predict the optimized coating architecture (stoichiometry, thickness and compositional gradient of each of the thin film layers in the multilayer coating system) that will result in a minimum level of both contact stresses and thermally induced stresses.

- **Field Tests** - The optimal coating system will be used on selected components, subjected to field tests at a pilot plant to evaluate their performance and reliability.

- **Analysis of all results, laboratory and field tests, industrial cost data** - A full analysis will be conducted of the optimized coating system(s), the laboratory and field results of each system, and the deposition processes used to produce each system.

Project Partners

Colorado School of Mines
Golden, CO

Ohio State University
Columbus, OH

North American Die Casting Association
Rosemont, IL

Blue Ridge Pressure Castings
Lehighton, PA

Hard Chrome
Evansville, IN

Hayes-Lemmerz
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SPX Contech
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December 2000